

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Docket No.: P27191

Douglas D. COOLBAUGH et al.

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Examiner: Shouxiang Hu

For: **STRUCTURE AND METHOD FOR HYPER-ABRUPT JUNCTION VARACTORS**

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

Commissioner for Patents  
U.S. Patent and Trademark Office  
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Alexandria, VA 22314

Sir:

This appeal is from the Examiner's final rejection of claims 16-29 as set forth in the Final Office Action of July 24, 2006. A Notice of Appeal and a Request For Pre-Appeal Brief Review, in response to the July 24, 2006 Final Office Action, was filed on October 24, 2006.

Payment in the amount of \$ 500.00 is being concurrently submitted as payment of the requisite fee under 37 C.F.R. 41.20(b)(2). No additional fee is believed to be required for filing the instant Appeal Brief. However, if for any reason a necessary fee is required for consideration of the instant paper, authorization is hereby given to charge the fee for the Appeal Brief and any necessary extension of time fees to Deposit Account No. 09-0456.

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**(I) REAL PARTY IN INTEREST**

The real party in interest is International Business Machines Corporation by an assignment recorded in the U.S. Patent and Trademark Office on January 23, 2004, at Reel 014280 and Frame 0587.

**(II) RELATED APPEALS AND INTERFERENCES**

No related appeals and/or interferences are pending.

**(III) STATUS OF THE CLAIMS**

Claims 16-29 are pending. Claims 16-29 stand finally rejected. Claims 1-15 are canceled. Thus, finally rejected claims 16-29 are at issue in the instant appeal and form the subject matter of the instant Appeal Brief. The claims in issue are attached in the "Claims Appendix".

**(IV) STATUS OF THE AMENDMENTS**

A Response under 37 C.F.R. § 1.116 was filed September 25, 2006, requesting reconsideration of the finally rejected claims. The Examiner responded with an Advisory Action mailed October 2, 2006, indicating that the Response was considered, but raised new issues and did not place the application in condition for allowance. Appellant submits that no amendments after final have been filed; however, all amendments to the claims have been entered.

**(V) SUMMARY OF THE CLAIMED SUBJECT MATTER****A. The Claimed Subject Matter****INDEPENDENT CLAIM 16**

With reference to page 5, line 26 to page 10, line 36 (paragraphs [0028] – [0051]) of the

instant application and to Figs 2-4, and by way of non-limiting example, the invention provides for a method of fabricating a varactor (see page 6, line 9 of the specification), comprising: providing a semiconductor substrate (42) (see page 6, line 9 and page 6, line 21 of the specification); doping a lower region (44) of the semiconductor substrate (42) with a first dopant at a first energy level (see page 6, lines 9-13 and page 6, lines 22-24 of the specification); doping a middle region (52) of the semiconductor substrate with a second dopant at a second energy level lower than the first energy level (see page 6, lines 9-13 and page 7, lines 18-21 of the specification); and doping an upper region (54) of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level (see page 6, lines 9-13, page 6, lines 16-21, and page 7, lines 28-29 of the specification).

#### **INDEPENDENT CLAIM 24**

With reference to page 5, line 26 to page 10, line 36 (paragraphs [0028] – [0051]) of the instant application and to Figs 2-4, and by way of non-limiting example, the invention provides for a method of fabricating a varactor (see page 6, line 9 of the specification), comprising: doping a lower region (44) of a substrate layer (42) with a first dopant having a dopant profile such that atoms having a first energy (“A”) penetrate to a first depth (“A’”) in the substrate layer forming a cathode and atoms having a second energy (“B”) penetrate to a second depth (“B’”) in the substrate layer forming a collector region above the cathode, wherein  $A > B$  and  $A' > B'$  (see page 6, lines 9-33, page 6 and page 7, lines 3-15 of the specification); doping a middle region (52) of the substrate layer with a second dopant, the middle region being tailored for an implant profile that forms an anode, the second dopant overlapping the collector region (see page 6, lines 9-13

and page 7, lines 16-24 of the specification); and doping an upper region of the substrate layer with a source/drain type implant to form the anode (see page 6, lines 9-13 and page 7, lines 25-33 of the specification). The doping of the middle region (52) has approximately less energy than the doping of the lower region (44) and the doping of the upper region (54) has approximately less energy than the doping of the middle region (see page 6, lines 22-24, page 7, lines 18-21, and page 7, lines 28-29 of the specification).

#### **INDEPENDENT CLAIM 29**

With reference to page 5, line 26 to page 10, line 36 (paragraphs [0028] – [0051]) of the instant application and to Figs 2-4, and by way of non-limiting example, the invention provides for a method of fabricating a varactor (see page 6, line 9 of the specification), comprising: forming a semiconductor substrate (42) (see page 6, line 9 and page 6, line 21 of the specification); doping a lower region (44) of the semiconductor substrate (42) with a first dopant at a first energy level (see page 6, lines 9-13 and page 6, lines 22-24 of the specification); doping a middle region (52) of the semiconductor substrate with a second dopant at a second energy level lower than the first energy level (see page 6, lines 9-13 and page 7, lines 18-21 of the specification); and doping an upper region (54) of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level (see page 6, lines 9-13, page 6, lines 16-21, and page 7, lines 28-29 of the specification). The semiconductor substrate includes a collector region (50) (see page 6, lines 14-17 of the specification) and a cathode (see page 7, line 3 of the specification) that are formed in a single doping step via energy distribution of a single dopant type (see page 7, lines 12-15 of the specification).

**(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

**Whether claim 28 is improperly rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.**

**Whether claim 28 is improperly rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.**

**Whether claims 16-18 and 24-29 are improperly rejected under 35 U.S.C. § 102(b) as being anticipated by JP 4-343479 to IGARASHI et al.**

**Whether claims 19-23 are improperly rejected under 35 U.S.C. § 103(a) as being Unpatenable over IGARASHI in view of Applicant's Admitted Prior Art (AAPA).**

**(VII) ARGUMENT RE. 112, 1<sup>ST</sup> PARAGRAPH REJECTION**

**REJECTION OF DEPENDENT CLAIM 28 UNDER 35 U.S.C. § 112, 1<sup>ST</sup> PARAGRAPH IS IN ERROR**

The rejection of claim 28 under 35 U.S.C. § 112, 1<sup>st</sup> paragraph as failing to comply with the written description is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner asserts that claim 28 fails to comply with the written description requirement. Appellant respectfully disagrees. The features asserted to be lacking in the written description support, i.e., that only three doping steps are utilized to form the varactor with a cathode, a collector, an HA junction, and an anode. These features can be found in paragraph [0049] of the instant specification which specifically states:

As thus described, the active region of the varactor including the cathode, collector, HA junction, and anode is formed by three doping steps. Each of the three doping steps has approximately less energy than the previous doping step in order to deposit its respective dopants at successively shallower depths. Because the active region of the varactor is formed solely by the doping steps, the C-V tuning curve of the resulting varactor is less affected by growing or etching steps, and there is less manufacturing variation from unit to unit. Thus, the resulting varactor is simpler and less expensive to fabricate, and may be manufactured to tighter tolerances.

Appellant directs the Examiner's attention to MPEP 2163 which specifically states:

To satisfy the written description requirement, a patent specification must describe the claimed invention in sufficient detail that one skilled in the art can reasonably conclude that the inventor had possession of the claimed invention (emphasis added).

The Examiner has simply not demonstrated that one skilled in the art cannot reasonably conclude that the inventor had possession of the claimed invention when claim 28 is compared to the disclosure of the specification and specifically paragraph [0049] thereof.

In addition, Appellant attempted to resolve this basis of rejection by proposing an amendment to claim 28 in the Rule 1.116 Amendment which arguably would have resolved this basis of rejection. The Examiner refused to enter this amendment. Regardless, Appellant submits that claim 28, even in its current form and properly interpreted, is fully compliant with the written description requirement.

Because the written description does in fact provide full and clear support for the features of claim 28, Appellant submits that claim 28 is fully compliant with the requirements of Section 112, 1<sup>st</sup> paragraph.

#### **(VIII) ARGUMENT RE. 112, 2<sup>nd</sup> PARAGRAPH REJECTION**

##### **REJECTION OF DEPENDENT CLAIM 28 UNDER 35 U.S.C. § 112, 2<sup>ND</sup> PARAGRAPH IS IN ERROR**

The rejection of claim 28 under 35 U.S.C. § 112, 2nd paragraph as being indefinite is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner asserts that claim 28 is indefinite because it recites that only three doping steps are utilized to form the varactor with a cathode, a collector, an HA junction, and an anode.

Appellant respectfully disagrees.

The Examiner has not demonstrated how one having ordinary skill in the art, having read the specification and drawings, would not understand what is claimed in claim 28. Appellant submits that contrary to the Examiner's assertions, Appellant is not required under section 112, 2<sup>nd</sup> paragraph, to limit the invention to any particular cooperative relationship between the recited doping steps. To the extent that the Examiner relies upon MPEP 2172.01, the Examiner has misread MPEP 2172.01, which indicates that when it is indicated "by applicant" in the specification that certain features are essential to the invention, such features must be recited in the claims. The Examiner has identified no features which were indicated "by Applicant" to be critical and which are not recited in the claims. In any event, claim 16 clearly recites the relationship between the doping steps.

Furthermore, as discussed above, support for the features of claim 28, which provides one having ordinary skill in the art with sufficient details for understanding what is claimed in claim 28, can be found in paragraph [0049] of the instant specification which specifically states:

As thus described, the active region of the varactor including the cathode, collector, HA junction, and anode is formed by three doping steps. Each of the three doping steps has approximately less energy than the previous doping step in order to deposit its respective dopants at successively shallower depths. Because the active region of the varactor is formed solely by the doping steps, the C-V tuning curve of the resulting varactor is less affected by growing or etching steps, and there is less manufacturing variation from unit to unit. Thus, the resulting varactor is simpler and less expensive to fabricate, and may be manufactured to tighter tolerances.

Thus, the Examiner has simply not demonstrated that one skilled in the art, having read the specification, would find the features of claim 28 indefinite.

Because claim 28 is not in fact indefinite, Appellant submits that claim 28 is fully compliant with the requirements of Section 112, 2<sup>nd</sup> paragraph.

**(IX) ARGUMENT RE. 102(b) REJECTION**

**REJECTION OF INDEPENDENT CLAIM 16 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 16 under 35 U.S.C. § 102(b) as being anticipated by JP 4-343479 to IGARASHI et al is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner asserted that IGARASHI discloses all of the features recited in this claim including, among other features, the three recited doping steps. Appellant respectfully disagrees and traverses this rejection.

Appellant submits that IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step. While the Examiner has provided an English language translation of this document, the Examiner has failed to identify the specific language which discloses each feature recited in the above-noted claims. As such, the Examiner has failed to set forth a *prima facie* case of anticipation.

Appellant emphasizes that IGARASHI has not been shown to disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has approximately less energy than the previous doping step. Appellant notes, in particular, that paragraphs [0012] and [0013] of the English language translation of IGARASHI disclose two ion implanting steps using different energy levels. On the other hand, the English language translation of IGARASHI

clearly does not specifically disclose doping three recited regions, much less, using the recited successively lower energy levels, i.e., (i) doping a lower region of the semiconductor substrate with a first dopant at a first energy level, doping a middle region of the semiconductor substrate with a second dopant at a second energy level lower than the first energy level, and doping an upper region of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level (claim 16). Using two different implanting steps with different energy levels, as taught by IGARASHI, is not the same as using three doping steps with successively lower energy levels.

Appellant submits that it is apparent from a fair reading the instant Final Office Action that the Examiner does not fully understand the requirements for a proper anticipation rejection.

Appellant directs the Board's attention to MPEP 2131 which specifically states:

**TO ANTICIPATE A CLAIM, THE REFERENCE MUST TEACH EVERY ELEMENT OF THE CLAIM**

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "When a claim covers several structures or compositions, either generically or as alternatives, the claim is deemed anticipated if any of the structures or compositions within the scope of the claim is known in the prior art." *Brown v. 3M*, 265 F.3d 1349, 1351, 60 USPQ2d 1375, 1376 (Fed. Cir. 2001) (claim to a system for setting a computer clock to an offset time to address the Year 2000 (Y2K) problem, applicable to records with year date data in "at least one of two-digit, three-digit, or four-digit" representations, was held anticipated by a system that offsets year dates in only two-digit formats). See also MPEP § 2131.02. "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). Note that, in some circumstances, it is permissible to use multiple references in a 35 U.S.C. 102 rejection. See MPEP § 2131.01.

Rather than complying with the above-noted requirements, the Examiner has instead chosen to ignore claim features and/or mischaracterize the claim features. The Examiner however must, consistent with MPEP 2131, identify each and every element as set forth in the claim is found, either expressly or inherently described. This has clearly not been done in this case.

Furthermore, to the extent that the Examiner is basing the instant rejection on an argument of inherency consistent with MPEP § 2112, Appellant notes that MPEP § 2112 specifically states, in part:

"In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original).

The Examiner has neither stated that the rejection is based on inherency, nor provided any basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least independent claim 16.

**REJECTION OF INDEPENDENT CLAIM 24 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 24 under 35 U.S.C. § 102(b) as being anticipated by JP 4-343479 to IGARASHI et al is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner asserted that IGARASHI discloses all of the features recited in this claim including, among other features, the three recited doping steps. Appellant respectfully disagrees and traverses this rejection.

Appellant submits that IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step. While the Examiner has provided an English language translation of this document, the Examiner has failed to identify the specific language which discloses each feature recited in the above-noted claims. As such, the Examiner has failed to set forth a *prima facie* case of anticipation.

As explained above, IGARASHI has not been shown to disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has approximately less energy than the previous doping step. Appellant notes, in particular, that paragraphs [0012] and [0013] of the English language translation of IGARASHI disclose two ion implanting steps using different energy levels. On the other hand, the English language translation of IGARASHI clearly does not specifically disclose doping three recited regions, much less, using the recited successively lower energy levels, i.e., (i) doping a lower region of a substrate layer with a first dopant having a dopant profile such that atoms having a first energy ("A") penetrate to a first depth ("A'") in the substrate layer forming a cathode and atoms having a second energy ("B") penetrate to a second depth ("B'") in the substrate layer forming a collector region above the cathode, wherein  $A > B$  and  $A' > B'$ , (ii) that the doping of the middle region has approximately less energy than the doping of the lower region and (iii) that the doping of the upper region has

approximately less energy than the doping of the middle region (claim 24). As explained above, using two different implanting steps with different energy levels, as taught by IGARASHI, is not the same as using three doping steps with successively lower energy levels.

Appellant again submits that it is apparent from a fair reading the instant Final Office Action that the Examiner does not fully understand the requirements for a proper anticipation rejection. Appellant again directs the Examiner's attention to MPEP § 2131 which was discussed above. Rather than complying with the above-noted requirements, the Examiner has instead chosen to ignore claim features and/or mischaracterize the claim features. The Examiner however must, consistent with MPEP § 2131, identify each and every element as set forth in the claim is found, either expressly or inherently described. This has clearly not been done in this case.

Furthermore, to the extent that the Examiner is basing the instant rejection on an argument of inherency consistent with MPEP 2112, Appellant again refers the Examiner to MPEP 2112 which was discussed above. At the very least, it is notable that the Examiner has neither stated that the rejection is based on inherency, nor provided any basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least independent claim 24.

**REJECTION OF INDEPENDENT CLAIM 29 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 29 under 35 U.S.C. § 102(b) as being anticipated by JP 4-343479 to IGARASHI et al is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner asserted that IGARASHI discloses all of the features recited in this claim including, among other features, the three recited doping steps. Appellant respectfully disagrees and traverses this rejection.

Appellant submits that IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step. While the Examiner has provided an English language translation of this document, the Examiner has failed to identify the specific language which discloses each feature recited in the above-noted claims. As such, the Examiner has failed to set forth a *prima facie* case of anticipation.

As explained above, IGARASHI has not been shown to disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has approximately less energy than the previous doping step. Appellant notes, in particular, that paragraphs [0012] and [0013] of the English language translation of IGARASHI disclose two ion implanting steps using different energy levels. On the other hand, the English language translation of IGARASHI clearly does not specifically disclose doping three recited regions, much less, using the recited successively lower energy levels, i.e., (i) doping a lower region of the semiconductor substrate with a first dopant at a first energy level, (ii) doping a middle region of the semiconductor

substrate with a second dopant at a second energy level lower than the first energy level, and (iii) doping an upper region of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level (claim 29). As explained above, using two different implanting steps with different energy levels, as taught by IGARASHI, is not the same as using three doping steps with successively lower energy levels.

Furthermore, although the Examiner has alleged on page 5 of the Final Office Action that the forming of a collector region and the cathode is “naturally formed in a single doping step via a naturally existing energy distribution of a single type of dopants”, the Examiner has failed to identify any language of IGARASHI (or any other prior art) which specifically supports this assertion.

Appellant again submits that it is apparent from a fair reading the instant Final Office Action that the Examiner does not fully understand the requirements for a proper anticipation rejection. Appellant again directs the Examiner’s attention to MPEP § 2131 which was discussed above. Rather than complying with the above-noted requirements, the Examiner has instead chosen to ignore claim features and/or mischaracterize the claim features. The Examiner however must, consistent with MPEP § 2131, identify each and every element as set forth in the claim is found, either expressly or inherently described. This has clearly not been done in this case.

Furthermore, to the extent that the Examiner is basing the instant rejection on an argument of inherency consistent with MPEP § 2112, Appellant again refers the Examiner to MPEP § 2112 which was discussed above. At the very least, it is notable that the Examiner has

neither stated that the rejection is based on inherency, nor provided any basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least independent claim 29.

**REJECTION OF DEPENDENT CLAIM 17 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 17 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on pages 4 and 5 of the Final Office Action that IGARASHI discloses forming a cathode of a varactor in the lower region, forming a hyper-abrupt junction in the middle region, and forming an anode in the upper region. However, because IGARASHI has been shown to lack the three recited regions (see arguments regarding the rejection of claim 16 above), Appellant respectfully disagrees IGARASHI can be shown to disclose forming a cathode of a varactor in the lower region, forming a hyper-abrupt junction in the middle region, and forming an anode in the upper region as recited in dependent claim 17, which depends from independent claim 16.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least dependent claim 17.

**REJECTION OF DEPENDENT CLAIM 18 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 18 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on pages 4 and 5 of the Final Office Action that IGARASHI discloses selecting the first dopant from a first N-type dopant, selecting the second dopant from a second N-type dopant, and selecting the third dopant from a P-type dopant. However, because IGARASHI has been shown to lack the three recited regions (see arguments regarding the rejection of claim 16), Appellant respectfully disagrees IGARASHI can be shown to disclose selecting the first dopant from a first N-type dopant, selecting the second dopant from a second N-type dopant, and selecting the third dopant from a P-type dopant as recited in dependent claim 18, which depends from independent claim 16.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least dependent claim 18.

**REJECTION OF DEPENDENT CLAIM 25 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 25 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on page 5 of the Final Office Action that IGARASHI discloses the forming of the collector region and the cathode are formed in a single doping step via energy

distribution of a single dopant type. However, as explained above, although the Examiner has alleged on page 5 of the Final Office Action that the forming of a collector region and the cathode is “naturally formed in a single doping step via a naturally existing energy distribution of a single type of dopants”, the Examiner has failed to identify any language of IGARASHI (or any other prior art) which specifically supports this assertion.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least dependent claim 25.

**REJECTION OF DEPENDENT CLAIM 26 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 26 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on page 5 of the Final Office Action that IGARASHI discloses an active portion of the varactor is formed in a column from the substrate layer which is a semiconductor material. However, although the Examiner has alleged on page 5 of the Final Office Action that the active portion is “naturally regarded as being formed in a column”, the Examiner has failed to identify any language of IGARASHI (or any other prior art) which specifically supports this assertion for a varactor of the type recited in claim 24 from which claim 26 depends.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI

renders anticipated the combination of features recited in at least dependent claim 26.

**REJECTION OF DEPENDENT CLAIM 27 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 27 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on pages 4 and 5 of the Final Office Action that IGARASHI discloses that the second dopant is deposited at a shallower depth than the first dopant and the third dopant is deposited at a shallower depth than the second. However, the Examiner has failed to identify any language of IGARASHI which specifically supports this assertion.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least dependent claim 27.

**REJECTION OF DEPENDENT CLAIM 28 UNDER 35 U.S.C. § 102 IS IN ERROR**

The rejection of claim 28 under 35 U.S.C. § 102(b) as being anticipated by IGARASHI is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner alleges on page 5 of the Final Office Action that IGARASHI discloses the features of claim 28 :insofar as being in compliance with 35 U.S.C. 112". Appellant submits that this assertion is legally insufficient to support an anticipation rejection. The Examiner has made a baseless assertion of anticipation and failed to identify any language of IGARASHI which specifically discloses the features in claim 28.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper reading of IGARASHI renders anticipated the combination of features recited in at least dependent claim 28.

**(X) ARGUMENT RE. 103(a) REJECTION**

**REJECTION OF DEPENDENT CLAIM 19 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 19 under 35 U.S.C. § 103(a) as being unpatentable over IGARASHI in view of AAPA is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that IGARASHI lacks the features recited in claim 19 but alleges on page 7 of the Final Office Action that AAPA (i.e., Fig. 1 of the instant application and the description thereof) teaches the missing features and that it would have been obvious to combine the teachings of IGARASHI with those of AAPA. Appellant respectfully disagrees.

Although not specifically addressed by the Examiner, in addition to the reasons already made of record, Appellant submits that AAPA does not disclose, or even suggest, the three recited doping steps of claim 16 (from which these claims depend), much less, that each of the three doping steps has less energy than the previous doping step.

Appellant notes, in particular, that the language in the instant specification describing Fig. 1 explains that the subcollector 14 is doped with a 40 KeV energy level, that the collector 16 is doped with a 700 KeV energy level, and that the HA junction 24 is doped with a 40 KeV energy level. Such language is clearly not suggestive of the three doping steps having approximately less energy than the previous doping step, as recited in the claims. Because, as noted above,

IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step, and because AAPA does not cure these deficiencies, Appellant submits that the Examiner has failed to set forth a *prima facie* case of unpatentability.

Furthermore, claim 19 further recites doping a bottom layer of the lower region of a higher concentration of the first dopant than an upper layer of the lower region. Although the Examiner has alleged that such features are “art known” (see page 7 of the Final Office Action), the Examiner has failed to identify any language in the AAPA, or any other prior art document, which would support this assertion.

To the extent that the Examiner is relying on Official Notice, Applicant reminds the Examiner that MPEP § 2144.03 specifically explains that “[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” Appellant submits that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellant respectfully requests that the Examiner produce documentary evidence to support the Examiner’s assertions to the extent that the Examiner is relying on official notice.

Appellant also submits that there is no motivation to modify IGARASHI in view of AAPA or what is asserted to be known in the art in a manner which would render obvious Appellant’s invention, and additionally, Appellant submits that there is no motivation or

rationale disclosed or suggested in IGARASHI or AAPA to modify IGARASHI in the manner suggested by the Examiner. The Examiner's opinion simply does not provide a proper basis for these features or for the motivation to modify or combine these documents in the manner suggested by the Examiner.

Appellant directs the Examiner's attention to the guidelines identified in M.P.E.P section 2141 which state that "[i]n determining the propriety of the Patent Office case for obviousness in the first instance, it is necessary to ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the reference before him to make the proposed substitution, combination, or other modification." *In re Linter*, 458 F.2d 1013, 1016, 173 USPQ 560, 562 (CCPA 1972).

As this section clearly indicates, "[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992)."

Moreover, it has been legally established that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990) .... Although a prior art device 'may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so.' 916 F.2d at 682, 16 USPQ2d at 1432.). See also *In re Fritch*, 972 F.2d 1260, 23 USPQ2d 1780 (Fed. Cir. 1992) (flexible

landscape edging device which is conformable to a ground surface of varying slope not suggested by combination of prior art references).”

Additionally, it has been held that a statement that modifications of the prior art to meet the claimed invention would have been “well within the ordinary skill of the art at the time the claimed invention was made” because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references. *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper combination of IGARASHI and AAPA renders unpatentable the combination of features recited in at least dependent claim 19.

**REJECTION OF DEPENDENT CLAIM 20 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 20 under 35 U.S.C. § 103(a) as being unpatentable over IGARASHI in view of AAPA is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that IGARASHI lacks the features recited in claim 20 but alleges on page 7 of the Final Office Action that AAPA (i.e., Fig. 1 of the instant application and the description thereof) teaches the missing features and that it would have been obvious to combine the teachings of IGARASHI with those of AAPA. Appellant respectfully disagrees.

Although not specifically addressed by the Examiner, in addition to the reasons already

made of record, Appellant submits that AAPA does not disclose, or even suggest, the three recited doping steps of claim 16 (from which these claims depend), much less, that each of the three doping steps has less energy than the previous doping step.

Appellant notes, in particular, that the language in the instant specification describing Fig. 1 explains that the subcollector 14 is doped with a 40 KeV energy level, that the collector 16 is doped with a 700 KeV energy level, and that the HA junction 24 is doped with a 40 KeV energy level. Such language is clearly not suggestive of the three doping steps having approximately less energy than the previous doping step, as recited in the claims. Because, as noted above, IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step, and because AAPA does not cure these deficiencies, Appellant submit that the Examiner has failed to set forth a *prima facie* case of unpatentability.

Furthermore, claim 20 further recites forming a collector of the varactor in the upper layer of the lower region of the semiconductor substrate. Although the Examiner has alleged that such features are “art known” (see page 7 of the Final Office Action), the Examiner has failed to identify any language in the AAPA, or any other prior art document, which would support this assertion.

Appellant also submits that there is no motivation to modify IGARASHI in view of AAPA or what is asserted to be known in the art in a manner which would render obvious Appellant’s invention, and additionally, Appellant submits that there is no motivation or rationale disclosed or suggested in IGARASHI or AAPA to modify IGARASHI in the manner

suggested by the Examiner. The Examiner's opinion simply does not provide a proper basis for these features or for the motivation to modify or combine these documents in the manner suggested by the Examiner.

Because the above-noted document fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellant submits that no proper combination of IGARASHI and AAPA renders unpatentable the combination of features recited in at least dependent claim 20.

**REJECTION OF DEPENDENT CLAIM 21 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 21 under 35 U.S.C. § 103(a) as being unpatentable over IGARASHI in view of AAPA is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that IGARASHI lacks the features recited in claim 21 but alleges on pages 6 and 7 of the Final Office Action that AAPA (i.e., Fig. 1 of the instant application and the description thereof) teaches the missing features and that it would have been obvious to combine the teachings of IGARASHI with those of AAPA. Appellant respectfully disagrees.

Although not specifically addressed by the Examiner, in addition to the reasons already made of record, Appellant submits that AAPA does not disclose, or even suggest, the three recited doping steps of claim 16 (from which these claims depend), much less, that each of the three doping steps has less energy than the previous doping step.

Appellant notes, in particular, that the language in the instant specification describing Fig. 1 explains that the subcollector 14 is doped with a 40 KeV energy level, that the collector 16 is doped with a 700 KeV energy level, and that the HA junction 24 is doped with a 40 KeV energy level. Such language is clearly not suggestive of the three doping steps having approximately less energy than the previous doping step, as recited in the claims. Because, as noted above, IGARASHI does not disclose, or even suggest, the three recited doping steps, much less, that each of the three doping steps has less energy than the previous doping step, and because AAPA does not cure these deficiencies, Appellant submit that the Examiner has failed to set forth a *prima facie* case of unpatentability.

Furthermore, claim 21 further recites forming at least one isolation region adjacent to the lower, middle, and upper regions of the semiconductor substrate. Although the Examiner apparently believes such features are taught in AAPA (see page 6 of the Final Office Action), the Examiner has failed to identify any language in the AAPA which would support this assertion.

Appellant also submits that there is no motivation to modify IGARASHI in view of AAPA or what is asserted to be known in the art in a manner which would render obvious Appellant's invention, and additionally, Appellant submits that there is no motivation or rationale disclosed or suggested in IGARASHI or AAPA to modify IGARASHI in the manner suggested by the Examiner. The Examiner's opinion simply does not provide a proper basis for these features or for the motivation to modify or combine these documents in the manner suggested by the Examiner.

Because the above-noted document fails to disclose, or even suggest, at least the above-

noted features of the instant invention, Appellant submits that no proper combination of IGARASHI and AAPA renders unpatentable the combination of features recited in at least dependent claim 21.

**(XI) CONCLUSION**

Each of claims 1-20 are patentable under 35 U.S.C. § 102(e). Specifically, the applied art of record fails to disclose or suggest the unique combination of features recited in Appellants' claims 1-20. Accordingly, Appellant respectfully requests that the Board reverse the decision of the Examiner to reject claims 1-20 under 35 U.S.C. §102(e), and remand the application to the Examiner for withdrawal of the above-noted rejections. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0456.

Respectfully submitted,  
Douglas D. COOLBAUGH et al.



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**Attachments:**

Claims Appendix  
Evidence Appendix  
Related Proceedings Appendix

**CLAIMS ON APPEAL**

16. A method of fabricating a varactor, comprising:  
providing a semiconductor substrate;  
doping a lower region of the semiconductor substrate with a first dopant at a first energy level;

doping a middle region of the semiconductor substrate with a second dopant at a second energy level lower than the first energy level; and

doping an upper region of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level.

17. The method of claim 16, further comprising forming a cathode of a varactor in the lower region, forming a hyper-abrupt junction in the middle region, and forming an anode in the upper region.

18. The method of claim 16, further comprising selecting the first dopant from a first N-type dopant, selecting the second dopant from a second N-type dopant, and selecting the third dopant from a P-type dopant.

19. The method of claim 16, further comprising doping a bottom layer of the lower region of a higher concentration of the first dopant than an upper layer of the lower region.

20. The method of claim 19, further comprising forming a collector of the varactor in the upper layer of the lower region of the semiconductor substrate.

21. The method of claim 16, further comprising forming at least one isolation region adjacent to the lower, middle, and upper regions of the semiconductor substrate.

22. The method of claim 16, further comprising forming at least one reach-through implant in electrical communication with the lower region of the semiconductor substrate.

23. The method of claim 16, further comprising forming a silicide layer on a top of the semiconductor substrate above the upper region.

24. A method of fabricating a varactor, comprising:

doping a lower region of a substrate layer with a first dopant having a dopant profile such that atoms having a first energy ("A") penetrate to a first depth ("A'") in the substrate layer forming a cathode and atoms having a second energy ("B") penetrate to a second depth ("B'") in the substrate layer forming a collector region above the cathode, wherein  $A > B$  and  $A' > B'$ ;

doping a middle region of the substrate layer with a second dopant, the middle region being tailored for an implant profile that forms an anode, the second dopant overlapping the collector region; and

doping an upper region of the substrate layer with a source/drain type implant to form the anode,

wherein the doping of the middle region has approximately less energy than the doping of the lower region and the doping of the upper region has approximately less energy than the doping of the middle region.

25. The method of claim 24, wherein the forming of the collector region and the cathode are formed in a single doping step via energy distribution of a single dopant type.

26. The method of claim 24, wherein an active portion of the varactor is formed in a column from the substrate layer which is a semiconductor material.

27. The method of claim 16, wherein the second dopant is deposited at a shallower depth than the first dopant and the third dopant is deposited at a shallower depth than the second.

28. The method of claim 16, wherein only three doping steps are utilized to form the varactor with a cathode, a collector, an HA junction, and an anode.

29. A method of fabricating a varactor, comprising:  
forming a semiconductor substrate;  
doping a lower region of the semiconductor substrate with a first dopant at a first energy level;  
doping a middle region of the semiconductor substrate with a second dopant at a second energy level lower than the first energy level; and  
doping an upper region of the semiconductor substrate with a third dopant at a third energy level lower than the second energy level,  
wherein the semiconductor substrate includes a collector region and a cathode that are formed in a single doping step via energy distribution of a single dopant type.

EVIDENCE APPENDIX

This section lists evidence submitted pursuant to 35 U.S.C. §§1.130, 1.131, or 1.132, or any other evidence entered by the Examiner and relied upon by Appellant in this appeal, and provides for each piece of evidence a brief statement setting forth where in the record that evidence was entered by the Examiner. Copies of each piece of evidence are provided as required by 35 U.S.C. §41.37(c)(ix).

NO.	EVIDENCE	BRIEF STATEMENT SETTING FORTH WHERE IN THE RECORD THE EVIDENCE WAS ENTERED BY THE EXAMINER
1	N/A	N/A

RELATED PROCEEDINGS APPENDIX

Pursuant to 35 U.S.C. §41.37(c)(x), copies of the following decisions rendered by a court of the Board in any proceeding identified above under 35 U.S.C. §41.37(c)(1)(ii) are enclosed herewith.

NO.	TYPE OF PROCEEDING	REFERENCE NO.	DATE
1	N/A	N/A	N/A